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Digital Camera Evaluation Base on AHP and TOPSIS

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***Abstract*—In the segment of camera, Digital Camera catered for a wide variety of customer taste and lifestyle. Some digital camera are compact, some offer unique appearance, some have sharp and high mega pixel for better picture quality. With all these high technological features, customer faces difficulties in selecting which digital camera to be purchase. In such situation TOPSIS and AHP are accurate and most reliable methods to be used. Using these tools, a customer can purchase the best digital camera as well as the manufacturing firm can produce unique quality of digital camera for that specific segment.**

***Keywords*—AHP, TOPSIS, Selection of digital camera.**

I. INTRODUCTION

In 1951, the first video tape recorder (VTR) captured live images from television cameras by converting the information into electrical impulses (digital) and saving the information onto magnetic tape. During the 1960s, NASA converted from using analog to digital signals with their space probes to map the surface of the moon (sending digital images back to earth).The rapid usage of digital camera have created a decision problem for buyer/ users nowadays since manufacturer have provided different type of digital camera in market which are of great quality, of light weight, attractive appearance and equipped with great features.

II. EVALUATION CRITERIA OF MOBILE PHONES

Digital camera with various size, color, picture quality and functioning are available in market. Out of which some famous brands are Canon, Sony, Panasonic, Nikon, Samsung and others.

The main specifications that describe digital camera are body, weight, picture quality, price, features and battery.

III. METHODOLOGIES

Multiple–criteria decision making method (MCDM) is a decision making analysis method which has been developed since 1970s. A decision-making problem is the process of finding the best option from all of the feasible alternatives. For many problems, the decision maker wants to solve a multiple criteria decision making (MCDM) problem. A MCDM problem can be concisely expressed in matrix format as:

$$D = \begin{array}{c} * \\ A1 \\ A2 \\ A3 \\ \vdots \\ Am \end{array} \begin{bmatrix} C1 & C2 & C3 & \cdots & Cn \\ x11 & x12 & x13 & \cdots & x1n \\ x21 & x22 & x23 & \cdots & x2n \\ x31 & x32 & x33 & \cdots & x3n \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ xm1 & xm2 & xm3 & \cdots & xmn \end{bmatrix}$$

$$W = [w1 \quad w2 \quad w3 \quad \ldots \quad wn]$$

Where *A1*, *A2*, *A3* ...., *Am* are possible alternatives among which decision makers have to choose, *C1*, *C2*, *C3*, ..., *Cn* are criteria with which alternatives performance are measured, *xij* is the performance value of alternatives *Ai* with respect to criterion *Cj*, *wj* is the weight of criterion *Cj*.

IV. ANALYTICAL HIERARCHY PROCESS (AHP) FOR WEIGHT DETERMINATION

The Analytic Hierarchy Process (AHP) is a theory of measurement through pair wise comparisons and relies on the judgments of experts to derive priority scales.
It is these scales that measure intangibles in relative terms. The comparisons are made using scale of absolute judgments that represents how much more, one element dominates another with respect to a given attribute. The judgments may be inconsistent, and how to measure inconsistency and improve the judgments, when possible to obtain better consistency is a concern of the AHP.
Each of these judgments is assigned a number on a scale. One common scale (adapted from Saaty) is:

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective.
3	Somewhat more important	Experience and judgement slightly favour one over the other.
5	Much more important	Experience and judgement strongly favour one over the other.
7	Very much more important	Experience and judgment very strongly favour one over the other.
9	Absolutely more important	The evidence favouring one over the other is of the highest possible validity.
2,4,6,8	Intermediate values	When compromise is needed.

V. TOPSIS

TOPSIS finds the best alternatives by minimizing the distance to the ideal solution and maximizing the distance to the nadir or negative-ideal solution. All alternative solutions can be ranked according to their closeness to the ideal solution. Because its first introduction, a number of extensions and variations of TOPSIS have been developed over the years. General TOPSIS process with six steps is listed below:

Step 1: Calculate the normalized decision matrix A. The normalized value (*aij*) is calculated as:

$$aij = \frac{xij}{\sum_{i=1}^{m}(xij)2} \quad , (1 \le i \le m, 1 \le j \le n)$$

Step 2: Calculate the weighted normalized decision matrix:
$V = (\, aij \; X \; wj)$
where *wj* is the weight of the i^{th} criterion and $\sum_{i=1}^{n}, w = 1$.

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Step 3: Calculate the ideal solution V^+ and the negative ideal solution V^-
$V^+ = \{v_1^+, v_2^+, .. v_n^+\} = \{ \text{Max } v_{ij} \mid j\in J), (\text{Min } v_{ij} | j\in J)\}$
$V^- = \{v_1^-, v_2^-, .. v_n^-\} = \{ \text{Min } v_{ij} \mid j\in J), (\text{Max } v_{ij} | j\in J)\}$

Step 4: Calculate the separation measures, using the m-dimensional Euclidean distance

$$S+ = \sqrt{\sum_{j=1}^{n}(V_{ij} \; - \; V^{+})^2}, \text{ where } (1 \le i \le m, 1 \le j \le n)$$

$$S- = \sqrt{\sum_{j=1}^{n}(V_{ij} \; - \; V^{-})^2}, \text{ where } (1 \le i \le m, 1 \le j \le n)$$

Step 5: Calculate the relative closeness to the ideal solution

$$Pi = \frac{s_i}{s_i^+ \; + \; s_i^-} \qquad (1 \le i \le m, 1 \le j \le n)$$

Where the larger is, P_i the closer the alternative is to the ideal solution.

Step 6: The larger TOPSIS value, the better the alternative.

VI. APPLICATION OF AHP & TOPSIS IN EVALUATION OF DIGITAL CAMERA

The decision matrix is figured in table as the customer wants to purchase a digital camera from camera outlet. For the weight determination and selection of digital camera AHP is applied. This weight is used in process of TOPSIS for evaluating ideal solution.

VII. APPLICATION OF AHP TO DETERMINE WEIGHT

As the decision matrix shown in Table, AHP is applied for weight determination. This weight will be used to evaluate the weighted normalized matrix in the TOPSIS. The weights of attributes are calculated by AHP which are (0.15, 0.14, 0.06, 0.18, 0.06, 0.11 and 0.30) respectively.

VIII. APPLICATION OF TOPSIS

According to TOPSIS, the outcomes are shown in Table. It is feasible to use AHP and TOPSIS to select the best digital camera from digital camera market.

IX. DECISION RESULT ANALYSIS

Following assumptions were considered for TOPSIS analysis for digital camera specification dimension (Less), weight (Lighter), mega pixel for better picture quality (High), price (Cheaper), shutter speed (High) and ISO speed (High). As per the result obtained in Table V, the best alternative can be chosen by the customer.

X. CONCLUSION

Eliminating the weighting specification, the output obtained from AHP and TOPSIS are accurate and objective. Using this tool, customer can take corrective decision for purchasing the digital camera as well as the from the manufacturer viewpoint it can be conclude that what the customer needs that specification from the ideal solution are obtainable from this tool.

XI. REFERANCES

[1] Cathal M. Brugha (1998), "Structuring and Weighting Criteria in Multi criteria Decision Making (MCDM)" 13th International Conference on Multi Criteria Decision Making, p.229-242.

[2] F. Hosseinzadeh Lotfi and R. Fallahnejad (2011), "Ranking efficient Units in DEA by Using TOPSIS Method", Applied Mathematics Sciences, Vol.5, no.17, 805-815.

[3] Hwang C.L., and Yoon K., (1981) "Multiple Attribute Decision Making: Methods and Applications" Springer-Verlag: New York.

[4] Tetteh Akyene (2012), "Cell Phone Evaluation Base on Entropy and TOPSIS", Interdisciplinary Journal of Research in Business, ISSN: 2046-7141 Vol. 1, Issue.12, pp.09-15.

[5] Thomas L. Saaty (2008), "Decision Making with the Analytical Hierarchy Process", International Journal of Services Sciences, Vol.1, No.1, 2008.

Table I. Digital camera specifications

Specification	Description
Body	Dimensions, Weight
Camera	Mega Pixels
Battery	Battery Life
Features	Shutter Speed, ISO Speed

Table II. Specifications of 4 different digital cameras available in the digital camera market.

	Dimensions (mm)	Weight (g)	Shutter Speed (Sec)	Camera Mega Pixel	ISO Speed	Battery Life (Shots)	Price (Rupees)
A1	579685.6	318	1/1600	16.1	1600	320	12595
A2	828247.68	415	1/1500	16.1	3200	350	12990
A3	162917.17	186	1/1500	14.1	6400	220	14000
A4	727069.77	390	1/2000	16.1	1600	380	12490

Table III. Data after Normalization using TOPSIS

	Dimensions (mm)	Weight (g)	Shutter Speed (Sec)	Camera Mega Pixel	ISO Speed	Battery Life (Shots)	Price (Rupees)

A1	0.4615	0.4688	0.5056	0.5152	0.2031	0.4951	0.4832
A2	0.6595	0.6118	0.5393	0.5152	0.4264	0.5415	0.4983
A3	0.1297	0.2742	0.5393	0.4512	0.8528	0.3404	0.5371
A4	0.5789	0.5749	0.4045	0.5152	0.2132	0.5879	0.4791

Table IV. Data after Weighted Normalization using TOPSIS

	Dimensions (mm)	**Weight (g)**	**Shutter Speed (Sec)**	**Camera Mega Pixel**	**ISO Speed**	**Battery Life (Shots)**	**Price (Rupees)**
A1	0.0692	0.06563	0.0303	0.0927	0.0127	0.0544	0.1449
A2	0.0989	0.0856	0.0323	0.0927	0.0255	0.0595	0.1494
A3	0.0194	0.0383	0.0323	0.0812	0.0511	0.0374	0.1611
A4	0.0868	0.0804	0.0242	0.0927	0.0127	0.0646	0.1437

Table V. Separation measures S_i^+, S_i^-, relative closeness (P_i) and ranking

	S_i^+	S_i^-	P_i	**Ranking**
A1	0.0559	0.0606	0.5204	3
A2	**0.0258**	**0.0971**	**0.7726**	**1**
A3	0.0970	0.0428	0.3064	4
A4	0.0448	0.0891	0.6652	2